

## **Appendix E**

### **Significance Evaluation of the Line 108 Suspension Bridge**

# **Significance Evaluation of the Line 108 Suspension Bridge over the Cosumnes River in Sacramento County, California**

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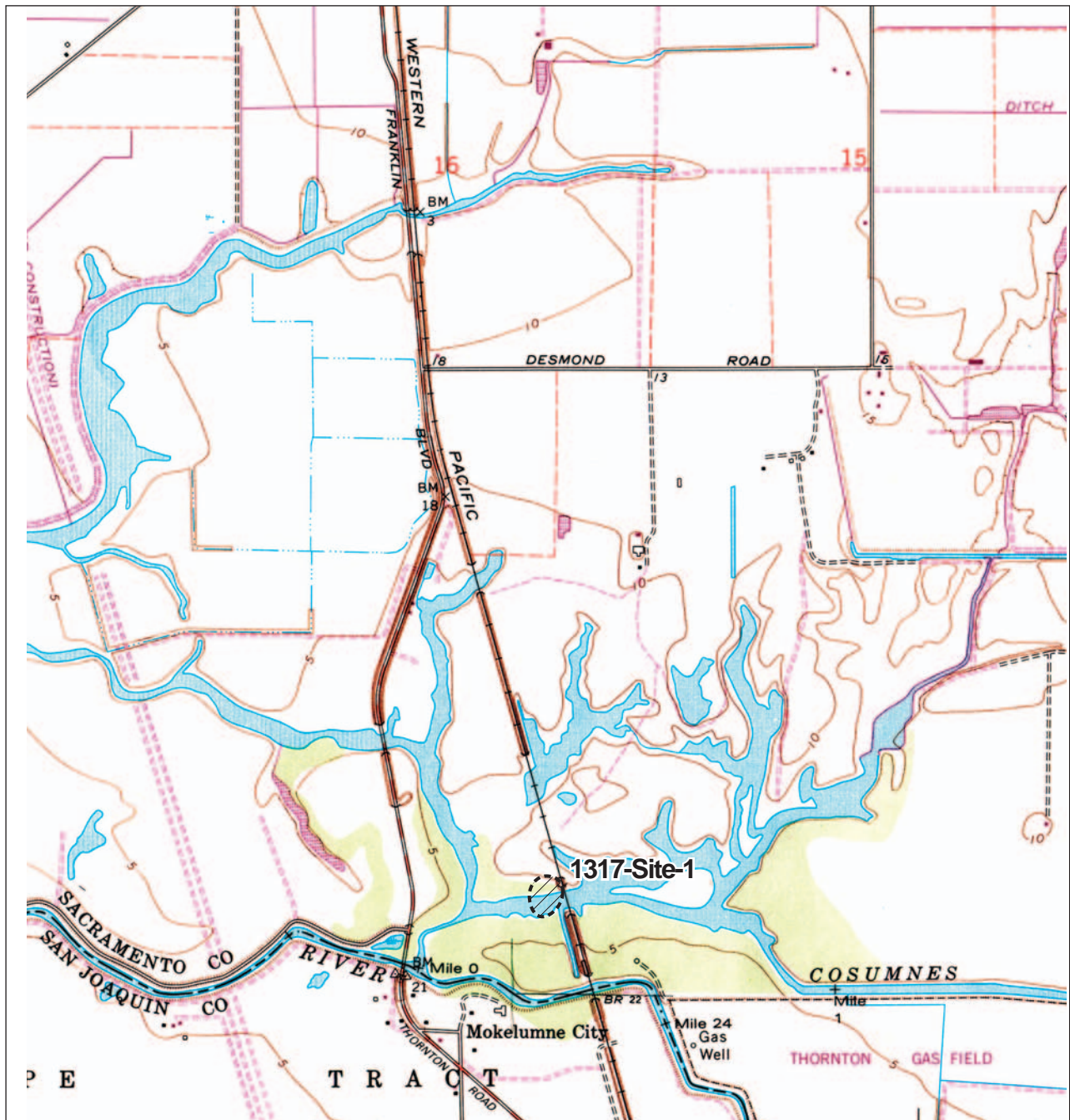
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## INTRODUCTION

Due to extensive growth throughout the greater Sacramento region, Pacific Gas and Electric Company (PG&E) proposes to install approximately 11 miles of 24-inch natural gas pipeline south of the community of Elk Grove in Sacramento County. The line will replace an existing 16-inch transmission line and will enhance the reliability of the existing natural gas supply system to the Sacramento area. The area of pipeline replacement starts just south of the confluence of the Cosumnes and Mokelumne rivers near the Thornton Meter Station in San Joaquin County. It extends north for about 11 miles, generally following the existing Western Pacific Railroad alignment, to the Elk Grove Station, just south of Elk Grove Boulevard in Sacramento County.

On behalf of Trigon EPC, Applied Earthworks, Inc. (Æ) performed a cultural resources inventory of the project area to identify archaeological sites, historical buildings, structures, and other cultural resources that may be affected by the proposed pipeline installation (Lloyd et al. 2006). One previously unrecorded historical resource, an abandoned suspension bridge at the south end of the project alignment, was documented as 1317-Site-1 (1). The Cosumnes River Conservancy is concerned about possible lead-paint contamination of the river from the bridge, which could adversely affect the riverine wildlife. Because of this and other liability issues, the bridge is scheduled for demolition. Installation of the new pipeline will be accomplished by drilling beneath the river bed. Following the cultural resource survey, Æ recommended that the bridge be evaluated for inclusion on the California Register of Historical Resources. Trigon, in turn, contracted with Æ to undertake a significance assessment. This report documents that effort.

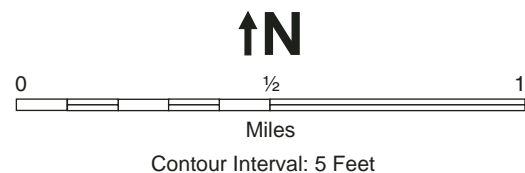
The proposed project is under the jurisdiction of the U.S. Army Corps of Engineers and is therefore considered a federal undertaking (per 36 CFR 800.16[y]) subject to the provisions of Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and other federal environmental statutes. Under these laws and regulations, permitting agencies are required to identify cultural resources, evaluate their eligibility for inclusion in the National Register of Historic Places (NRHP), and consider alternatives for the treatment of project effects on significant resources.



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Prepared by Applied EarthWorks, Inc.

U.S.G.S. 7.5 Minute  
Topographic Quadrangle  
**Bruceville, CA**  
T 5 N - R 5 E  
1968, Photorevised 1980



**Figure 1** Location of the Line 108 suspension bridge.

## **2 METHODS**

### **2.1 RECORDS SEARCH**

Prior to the cultural resources survey for the Line 108 Replacement Project (Lloyd et al. 2006), a records search was completed by the staff of the North Central Information Center of the California Historical Resources Information System housed at California State University, Sacramento on 17 December 2004. Late project realignments outside of the search corridor necessitated two additional records searches; one conducted at the North Central Information Center by Æ Archaeologist Jay Lloyd on 8 February 2006, and one conducted on 9 February 2006 by the staff of the Central California Information Center at California State University, Stanislaus.

The records searches covered a 0.5-mile-wide study area encompassing the pipeline corridor and a 0.25-mile buffer on each side. The records search was conducted to identify locations of previous archaeological investigations and previously recorded prehistoric and historical sites and features within the study area. This was accomplished by a review of the information center's files and base maps, including the current Florin, Bruceville, and Thornton (formerly New Hope) 7.5-minute U.S. Geological Survey topographic quadrangles as well as listings on the National Register of Historic Places; the Office of Historic Preservation Historic Property Directory (HPD); the California Historical Resources Inventory (1976); California Department of Transportation Bridge Inventory (1987, 2000); California Historical Landmarks (1996); California Points of Historical Interest; the 1855 General Land Office (GLO) plat of T6N/R5E; the 1907 GLO plant of T7N/R5E; and the Lodi (1894), New Hope (1907), Florin (1909), and Bruceville (1910) historic quadrangles. The Line 108 suspension bridge had not been previously recorded, nor was it listed in any of the above sources consulted.

### **2.2 FIELDWORK**

Æ completed an intensive pedestrian survey for the Line 108 Replacement Project in November and December 2005. Wendy Nettles, Æ Historical Archaeologist/Architectural Historian, visited the bridge site on 20 December 2005. Digital photographs were taken to document structural elements and the current condition of the bridge. Æ Architectural and Landscape Historian Peggy Beedle revisited the site on 16 June 2006. Further evaluation for this report was not possible because the area around the bridge was completely flooded.

### **2.3 RESEARCH**

The significance evaluation of the bridge was based on the photographs and field observation by the historical archaeologist during December 2005, archival research, and e-mail communications with PG&E archaeologists. Specifically, PG&E cultural resources staff was consulted about other suspension bridges of contemporary age in the pipeline system. Further research was undertaken at the Huntington Library in San Marino, the Los Angeles Public Library, and online sources.

### 3 HISTORICAL BACKGROUND

The first oil and natural gas well was excavated in Pennsylvania in 1859, and a 5.5-mile pipeline was constructed to carry gas from the well to Titusville (City of Mesa 2004). By 1872, long-distance pipelines were being constructed. A noteworthy distance of 120 miles was covered by a natural gas pipeline laid from central Indiana to Chicago in 1891. This gas was slowly siphoned to urban consumers, who relied on manufactured gas for heat and lighting. Manufactured gas, derived from coal, was not as clean and did not burn as brightly as natural gas. Natural gas gradually supplanted manufactured gas during the twentieth century.

#### 3.1 ORIGIN AND HISTORY OF PACIFIC GAS AND ELECTRIC COMPANY

Pacific Gas and Electric Company was founded in San Francisco, California, in 1905, through the merger of the San Francisco Gas and Electric Company and the California Gas and Electric Corporation. As natural gas became the dominant fuel, PG&E focused on serving the San Francisco area, then expanded to the San Joaquin Valley and the Sacramento area, where Line 108 is located. Charles M. Coleman's book, *P. G. and E. of California: The Centennial Story of Pacific Gas and Electric Company 1852–1952* provides an excellent story of the development of the natural gas market in California and is quoted extensively in this context.

Late in the 1920s, Northern California witnessed the beginning of a remarkable utility development which brought cleaner, cheaper cooking and heating to housewives, low-cost space heating to hotels and office buildings, and the many advantages of a more efficient fuel to industry. This was P. G. and E.'s successful piping of natural gas from distant oil fields to the principal cities of its service area [Coleman 1952:299].

Steel pipes with welded seams added to this development, supplanting cast iron pipes, which eroded more easily (City of Mesa 2004).

By 1924 Southern California cities were being served by 28 gas and oil fields, but no economical source had yet been found for the San Francisco Bay area. The nearest major wells were at Elk Hills and Ventura. Not only was their production insufficient to provide the reserve and continuous supply necessary, but the fuel could not be piped to distant markets at a low enough cost to enable it to compete with oil, coal, or manufactured gas [Coleman 1952:300].

Then in 1926 the picture changed abruptly. Probing for oil in the vicinity of Elk Hills, the Milham Exploration Company, organized and owned by Ogden Mills and John Hays Hammond, brought in a big gas well at Buttonwillow, 28 miles west of Bakersfield and 250 miles southeast of San Francisco. Tests revealed the existence of a large underground supply of "dry" (or oil-free) gas under high pressure and having a heating value of 1,000 to 1,150 British thermal units, about twice that of gas made from oil. The discovery, plus the "surplus" gas then available from Ventura and the parallel development of electrically welded, large-diameter steel pipe, made it possible for P. G. and E. to consider seriously the introduction of natural gas into its territory [Coleman 1952:300–301].

P. G. and E. President A. F. Hockenbeamer entered into negotiations with the Milham Exploration Company and the Southern California Gas Company for purchase of gas and for construction of a pipeline that would link Ventura, Buttonwillow, and San Francisco. Southern California fieldmen had already surveyed a portion of the projected line and a contract was soon drawn up. But it was destined to remain unsigned. For the very morning the document was placed on his desk, Hockenbeamer opened his newspaper to a one-paragraph item announcing that the day before, October 6, 1928, the Milham company had brought in an apparently bigger gas well in the Kettlemen Hills, 49 miles northwest of the one at Buttonwillow [Coleman 1952:301].

Hockenbeamer made a tour of the new wells and decided to tap both the Buttonwillow and the Kettlemen Hills discoveries—a job that called for the initial expenditure of \$13,000,000 for the construction of the longest pipe line in the West. In a public announcement the president explained:

“This undertaking will prove the greatest contribution of this generation to the growth and development of the Bay area. Natural gas is a cheap and efficient fuel which will not only attract new industries but keep the old ones here. . . . Domestic consumers will also profit. With increased heating values and with rate adjustments we propose to make, consumers in the Bay area will save \$3,000,000 a year in their gas bills.”

This promise, as we shall see, was well kept, the annual saving proving to be ten million dollars instead of three [Coleman 1952:301–302].

The Company entered into contracts with the Milham Exploration Company, the Texas Company, and the Standard Oil Company of California for purchase of gas from the two fields. In January, 1929, construction of the pipe line was begun. The job was completed seven months later. The pipe line, 250 miles long, consists of a 16-inch main from Buttonwillow to a compressor station in the Kettlemen Hills, a 22-inch line to Panoche Junction (west of Mendota) in Fresno County, and a 20-inch line which swings through Panoche Pass to Tres Pinos and thence to the metering station at Milpitas, on the southern tip of San Francisco Bay. At Milpitas, a branch runs along the eastern shore of the Bay to Oakland and Richmond, while the main stem continues 44 miles to San Francisco. Capacity is approximately 100 million cubic feet per day [Coleman 1952:302].

During construction of this line, P. G. and E. began to look ahead to expansion in the north. Plans were drawn up to build another large transmission line from the oil fields up the west side of the San Joaquin Valley to the oil refinery cities of Martinez and Richmond on the eastern shore of San Francisco Bay. A branch line through the Livermore Valley from Tracy would tie into the station at Milpitas, while another line would serve the cities of Stockton, Lodi, and Sacramento. The entire network would thus not only bring natural gas into all the cities of the Bay area but provide a complete loop which could be tapped to supply all the Company’s territory in Northern and Central California [Coleman 1952:302].

Work on the Valley line, as it was called, was begun, but plans were changed when P. G. and E. learned that Standard Oil of California intended to build a line of its own to its Richmond refinery. To avoid duplication, the two companies agreed to join forces to construct and operate a line of greater capacity than originally contemplated. This line, which ends at Richmond by way of Antioch and Pittsburg, was completed in 1930, and in

July of that year the two companies formed a new corporation known as Standard-Pacific Gas Line, Inc., which now owns and operates it [Coleman 1952:302–303].

“The extent to which retail users have benefited by the introduction of natural gas,” said the Company’s annual report for 1932, “may be inferred from the fact that the revenue received from commercial and domestic consumers in 1932, while still greater than in either of the two preceding years, was still \$1,946,519 or 9 per cent less than in 1929, the last year of artificial gas, notwithstanding the enlarged usage reflected in the delivery of 78 per cent more heat units. More than 85 per cent of the \$2,539,658 derived from sales of natural gas to industrial consumers represents business added during the last three years which could not have been secured with manufactured gas. We estimate that the use of natural gas is saving all classes of customers about \$10,000,000 per annum at the present rate of consumption” [Coleman 1952:305–306].

The growth and development of the natural gas industry was greatly expanded by the demands of World War II industry and the subsequent suburbanization of California. PG&E piped in gas from outside California to meet the demand. By 1951, the company controlled “a network of 14,300 miles of gas pipe line branching into 33 California counties” (Coleman 1952:308). Post–World War II innovations included welding techniques, pipe rolling and metallurgical advances that afforded high-quality pipelines (Natural Gas 2004).

### **3.2 THE SHORT-SPAN SUSPENSION BRIDGE**

Vernalis Sacramento Line 108 was part of PG&E’s expansion north of San Francisco into the Sacramento area. The line crossed the Cosumnes River on a short-span suspension bridge. Suspension bridges have been constructed since ancient times. In 1801 the Jacobs Creek Bridge near Uniontown, Pennsylvania, was the first suspension bridge constructed in the United States (Chen and Duan 1999:18-1). In 1849 Charles Ellet, Jr. constructed a long-span wire-cable suspension bridge over the Ohio River at Wheeling, West Virginia (American Society of Civil Engineers 2006). This bridge, now a National Historic Landmark, was the first major suspension bridge in the United States, and inspired the design and construction of later bridges. In 1883 steel wires were originally used during the construction of the Brooklyn Bridge, which is considered the first modern suspension bridge. In 1936 and 1937 the San Francisco-Oakland Bay Bridge and the Golden Gate Bridge, respectively, were constructed.

A suspension bridge consists of four basic components: abutments, towers, deck, and cables. The deck is suspended by the cables, which run over the tops of the towers and are embedded in the abutments. The deck, or floor, is composed of stiffening girders/trusses: “longitudinal structures which support and distribute . . . loads, act as chords for the lateral system and secure the aerodynamic stability of the structure” (Chen and Duan 1999:18-3). The cables support the deck by hanger ropes and transfer loads to the towers. The towers are vertical structures that support the cables and transfer the bridge loads to their foundations. The abutments anchor the main cables and are the end supports of the bridge.

Along with their more famous counterparts, short-span suspension bridges were constructed around the world. A bridge with a main span of 700–800 feet was considered to be a short-span suspension bridge (Frankland 1934:9). “In the early 20th century they were also popular in parts of the South and West for small-scale highway bridges” (Jackson 1988:35). Although the long-

span bridges are the most spectacular, smaller suspension bridges were considered economical to build. These small bridges were “soundly economic, but also graceful, substantial and altogether pleasing in appearance” (Frankland 1934:9).

In the 1930s the short-span suspension bridge was classified into two basic types: (1) those with wire rope, wire strands, or parallel wire cables, and (2) those that used eye-bar chains (Frankland 1934:13). Further typology depended on the “character of the stiffening girders/trusses” (Frankland 1934:13). These can be two-hinged or continuous (Chen and Duan 1999:18-4). Towers were constructed with either a fixed or rocker-type base.

A lateral bracing system provided stiffness that resisted high winds. Also, for “very narrow bridges—such as long pipe line and foot bridges—wind-anchor cables provide the most efficient means of securing lateral stability” (Frankland 1934:53).

Short-span suspension bridges were economical to build. Also, “transportation and erection difficulties are invariably less for suspension bridges than for any other type of permanent structure, consequently the suspension type particularly recommends itself for those locations where these considerations are important” such as rural environments (Frankland 1933:109). Another characteristic of suspension bridges was their wide clearance, which was an important factor for bridges over rivers with boat traffic (Jackson 1988:35).

## 4 BRIDGE EVALUATION

In 1932 PG&E constructed the Vernalis-Sacramento high-pressure natural gas Line 108 that crossed the Cosumnes River. The PG&E General Construction Department built a suspension bridge to carry the pipeline over the river. The pipeline has since been removed, but the bridge remains (2).



**Figure 2**      **Line 108 suspension bridge, view to the southwest.**

### 4.1 ENVIRONMENTAL SETTING

The project area lies within the geomorphic province of the Great Valley, a virtually uninterrupted lowland stretching approximately 500 miles from Red Bluff to Bakersfield. Situated between the Coast Range to the west and the Sierra Nevada to the east, the Great Valley receives water from both ranges, although the volume of runoff is significantly higher from the latter. Countless rivers and tributaries flow into the Sacramento or San Joaquin River, which in turn drain the valley into San Francisco Bay via Suisin Bay and the Carquinez Strait. Before the reclamation and hydroelectric projects of the nineteenth and twentieth centuries, wetlands and sloughs pervaded the valley, and the river channels were prone to seasonal flooding. The Sacramento Delta region lies immediately west of the proposed pipeline and undoubtedly has enveloped the project corridor in prehistoric times. The estuarine habitat contains a wealth of fowl, fish, and other game. Early Euro-American settlers understood that the Delta's alluvial sediments could be transformed into rich farmland; they constructed levees and drainage systems

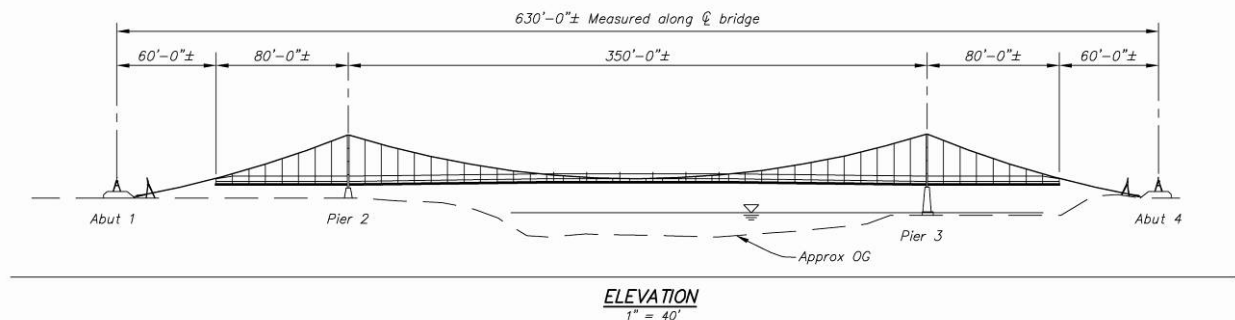
to reclaim the swampland, which generally lies at or below sea level. In addition, the accumulation of organic material over geologic time created thick deposits of peat, which have made the Stockton area one of the major sources of natural gas in the state (Lloyd et al. 2006:2.1).

Two rivers are associated with the project area. The Cosumnes River is the last undammed waterway on the western slope of the Sierra Nevada. This 80-mile-long river emanates from the Eldorado National Forest and descends the western slope of the Sierra Nevada, terminating at the confluence with the Mokelumne River in the Sacramento-San Joaquin Delta. The Mokelumne River originates high in the Sierra Nevada in the Mokelumne and Carson-Iceberg Wilderness areas. In several places along its westward descent, the Mokelumne's waters are dammed. Water not stored in reservoirs flows to the Sacramento-San Joaquin Delta.

The Cosumnes and Mokelumne rivers converge just east of Thornton Road near Mokelumne City on the boundary between Sacramento and San Joaquin counties. The subject pipeline bridge crosses the Cosumnes River approximately 2,000 feet east of this confluence. The bridge lies in the Cosumnes River floodplain, an ecologically sensitive area containing some of the only remaining oak groves, sloughs, and wetlands that were once prolific in the Delta region. Because this river is undammed, the natural process of flooding and silt deposition still occurs, resulting in an ecologically diverse environment. The erosion of lead paint from the bridge is threatening this fragile balance.

## 4.2 BRIDGE DESCRIPTION

The bridge location is just east of the Southern Pacific Railroad bridge over the same river. The bridge runs north-south, approximately 630 feet from anchor block to anchor block. The piers are approximately 350 feet apart (3). The bridge is constructed of rolled and fabricated steel, with poured reinforced concrete piers and abutments. At the time of the survey in December 2005, only the northern end of the bridge was accessible by foot, and the bridge was judged unsafe to cross. The site was revisited in June 2006, but the entire area near the river was flooded.



**Figure 3** Elevation of Line 108 pipeline bridge.

The abutments consist of concrete external anchor blocks to which the cables are attached. The abutments are 2 feet high, 19 feet long, and 14 feet wide. The pipeline traveled over the abutments, supported by A-framed pipe legs (4).